REMARKS

Reconsideration of the application is respectfully requested.

I. Status of the Claims

Claims 12-46 stand rejected.

Claim 1-11 were previously canceled without prejudice or disclaimer of the subject matter therein.

Claims 12-46 are pending in the application.

II. Examiner Interview

Applicants' attorney, Pierre Yanney, conducted a telephone interview with Examiner Coughlan on February 5, 2009. William Johnson, a law clerk associated with Applicants' attorney, also attended the interview. Applicants' attorney thanks Examiner Coughlan for the courtesies extended by the Examiner during the interview. During the interview, the rejections were discussed and the Examiner considered Applicants' proposal to overcome the rejections set forth in the December 31, 2008 Office Action. Pierre Yanney described an oscillation signal and two thresholds according to the present invention. Mr. Yanney specifically described a non-limiting embodiment of the present invention, wherein the first threshold is located above the oscillation signal and the second threshold is located below the oscillation signal. Applicants and their representatives deeply appreciate the Examiners' thorough preparation and the careful attention accorded by the Examiner to this application and to Applicants' position.

Applicants acknowledge receipt of the Examiner's Interview Summary mailed on February 9, 2009, wherein the Examiner indicates that agreement was reached with respect to claim 12.

The present response, submitted in accordance with the above-mentioned interview of February 5, 2009, is intended to be fully responsive to all points of rejection and is believed to place the application in condition for allowance. Favorable reconsideration and allowance of the present application are hereby respectfully requested.

III. Rejections Under 35 U.S.C. § 112

Claims 19, 27, 36 and 44 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse these rejections.

Claims 19, 27, 36 and 44 require "a first cluster of control circuits and a second cluster of control circuits, the first cluster of control circuits being characterized by a higher degree of coupling between control circuits of the first cluster relative to a lower degree of coupling between control circuits of the first cluster and control circuits of the second cluster." According to the Examiner, these claims fail to satisfy the written description requirement because the specification, which states "[g]enerally, the coupling between units inside a cluster is stronger than between units at the boundary of clusters," is not as precise as the claims. (Detailed Action, Page 3).

The claims of the present invention are directed to a model of the inferior olive neuron. With respect to the inferior olive neuron, the specification makes clear that "[a]s the coupling among neurons increases, the degree of synchronization of the neurons increases. As has been experimentally observed, closely coupled IO neurons form oscillatory clusters." (Specification, Page 27, Lines 5-7). Thus, inferior olive neurons form clusters when closely coupled. Because cluster formation is a function of the degree of coupling between neurons, it follows that neurons within a cluster are more closely coupled to other neurons within the same cluster than they are to neurons in a different cluster. Claims 19, 27, 36, and 44 are directed to this feature of the neuron model. Accordingly, Applicants submit that these claims comply with the written description requirement.

IV. Rejections Under 35 U.S.C. § 103

Claims 12, 13, 18-21, 26-30, 35-38, 43, 44 and 46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over "Microelectronic circuits" by Sedra et al. ("Sedra") in view of "Cerebellar Learning for Control of a two Link Arm in Muscle Space" by Fagg et al. ("Fagg"). Applicants respectfully traverse these rejections.

Claims 14-17, 22-25, 31-34, 39-42 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Sedra and Fagg in view of "Homoclinic orbits and solitary waves in a one dimensional array of Chua's circuits" by Nekorkin et al. ("Nekorkin"). Applicants respectfully traverse these rejections.

Claim 45 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Sedra and Fagg in view of U.S. Patent No. 4,720,689 to Gontowski ("Gontowski"). Applicants respectfully traverse these rejections.

As discussed during the Examiner interview held on February 5, 2009, claim 12 is directed to a circuit for controlling an actuator. The control circuit generates an oscillation output signal. When the oscillation output signal crosses a first threshold, the control circuit generates a first spike. Similarly, when the oscillation output signal crosses a second threshold, the circuit generates a second spike. The oscillation output signal, the first spike signal and the second spike signal collectively form a composite output signal which is capable of controlling an actuating element. Additionally, characteristic information of the actuating element is provided as part of the input signal to the control circuit to thereby adjust one of the amplitude, phase and frequency of the oscillation output signal. Thus, feedback is provided to the control circuit so that the control circuit can adjust the composite signal in response to the state of the controlled actuating element.

Spike generation is dependent upon the frequency of the oscillation signal and the threshold levels. "[T]he firing frequency of the IO neurons is limited by the frequency of the sub-threshold oscillations as the action potential is generated only at voltages near the peak of the oscillation." (Specification, Page 18, Lines 17-19). However, "the firing frequency can be tuned with the parameters I_1 and I_2 of Eqs. 2a, 2b and 3a, 3b whose values move the base line of the sub-threshold oscillations up or down with respect to the spike firing thresholds." (Specification, Page 18, Lines 15-17).

Generation of spikes when the oscillation signal crosses a threshold is described, for example, in Page 17, Line 6 – Page 18, Line 22 of the Specification. "At rest, the oscillations of the membrane potential are below the spike-inducing threshold." (Specification, Page 17, Lines 10-11).

Spiking occurs when the membrane of the IO neuron is depolarized to the point at which the threshold for spiking is met. (Specification, Page 17, Lines 15-17). Spikes due to depolarization are generated by the high-threshold pulse generator 12: "[t]he spiking is generated by the high-threshold pulse generator…." (Specification, Page 17, Lines 17-18). "[I]n addition to firing at depolarized levels, the IO neuron model 10 also fires at hyperpolarized levels…." (Specification, Page 17, Lines 20-21). "In the case of hyperpolarization, the low threshold spikes are generated by the activation of the [low-threshold] pulse generator 13." (Specification, Page 18, Lines 3-5). Thus, spikes are fired by the high-threshold pulse generator 12 when the oscillating signal crosses a first threshold, and are fired by the low-threshold pulse generator 13 when the oscillation signal crosses a second threshold.

Examples of composite signals including an oscillation signal and spikes according to an exemplary model of the present invention can be found in Figs. 5 and 6 of the Specification. Fig. 5A illustrates the output of an exemplary model of the present invention for a depolarized condition, which corresponds to the oscillation signal crossing the first threshold. Fig. 6A illustrates the output of an exemplary model of the present invention for a hyperpolarized condition, which corresponds to the oscillation signal crossing the second threshold. Note that the labeling of the first threshold and the second threshold in the description above is arbitrary.

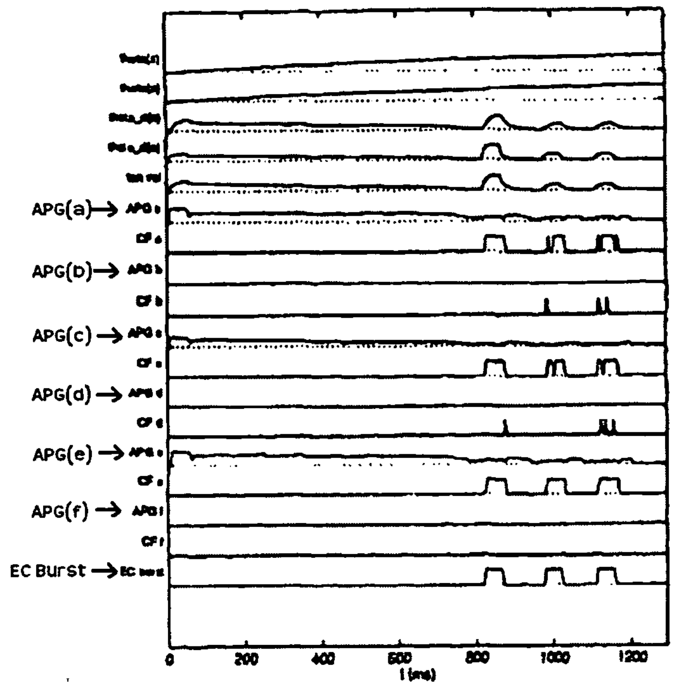
With respect to independent claim 12, the Examiner contends that Sedra teaches a plurality of control circuits comprising an input receiving connection for receiving an input signal and an oscillation generation circuit for generating at a first output terminal an oscillation output signal having an amplitude, a phase, and a frequency. (Detailed Action, Page 4). The Examiner further contends that Sedra discloses adjusting the amplitude and the frequency of the oscillation output signal. (Detailed Action, Page 7). The Examiner admits that Sedra does not teach the remaining claim limitations, but contends that Fagg discloses these limitations. (Detailed Action, Page 4).

As discussed during the Examiner interview held on February 5, 2009, Applicants respectfully disagree with the Examiner's contention that the combination of Sedra and Fagg discloses all of the limitations of claim 12.

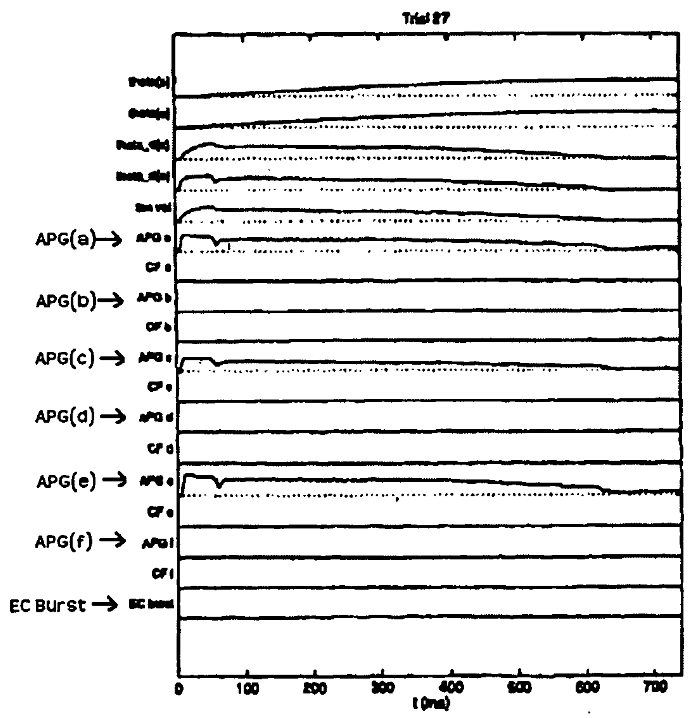
Applicants submit that Fagg discloses a model for simulating the movement of an arm. Arm movements are controlled by two different control modules and an inferior olive module (Fagg, Pages 2638–2639). The first control module is the cerebellar module, which is constructed from an array of adjustable pattern generators ("APGs"), each of which drives a single muscle. (Fagg, Page 2638). The cerebellar module is a learning module that is primarily responsible for moving the arm to a goal. (Fagg, Pages 2638–2639) The second control module is the Extra-Cerebellar ("EC") module, which is responsible for moving the arm to the goal when the cerebellar module fails to move the arm close enough to the goal. (Fagg, Page 2639). When activated, the EC module produces a short constant burst of activity in muscle space that brings the arm closer to the goal. (Fagg, Page 2639). The inferior olive estimates movement errors by observing muscle length changes in response to corrective motor commands generated by the EC module. (Fagg, Page 2639). This error information is used to update the APGs. (Fagg, Page 2639). Ideally, after a number of attempts and as a result of this learning process, the cerebellar module can move the arm to the goal without the help of the EC module.

According to the Examiner, Fagg teaches "a first spike generation circuit in communication with the oscillation generation circuit for generating a first spike signal when the oscillation output signal crosses a first threshold value," as required by claim 12. (Detailed Action, Page 5). Specifically, the Examiner contends that the APG of Fagg is equivalent to the first spike generation circuit. (Detailed Action, Page 5). The Examiner also states that "[t]he 'first threshold' of applicant is disclosed by the desire to move the 'single muscle' of Fagg." (Detailed Action, Page 5).

Applicants respectfully submit that, contrary to the Examiner's contention, the APG of Fagg is not a spike generator. Figures 5 and 7 of Fagg illustrate the signals that drive the muscles that move the arm. (Fagg, Pages 2642-2643). Figs. 5 and 7 of Fagg are reproduced below for the convenience of the Examiner. As can be seen from these figures, the signals APG(a)-APG(f), are not comprised of spikes, but instead vary smoothly with no discernable pattern.



Fagg, Fig. 5 (Labels to left added for clarity)



Fagg, Fig. 7 (Labels to left added for clarity)

Further, Applicants respectfully submit that the Examiner mischaracterizes the "first threshold" requirement of claim 12. The first and second thresholds of claim 12 correspond to signal levels that the output of an oscillation circuit crosses. The output of a circuit is a signal having a voltage and a current, and thus, the threshold corresponds to a signal level associated with either the voltage or current of the signal. In contrast, the Examiner's contention is that the first threshold corresponds to a desire to move a single muscle of the modeled arm. (Detailed Action, Page 5). A desire to move a muscle is not the same as the first threshold required by claim 12.

According to the Examiner, Fagg also teaches "a second spike generation circuit in communication with the oscillation generation circuit for generating a second spike signal when the oscillation output signal crosses a second threshold value," as required by claim 12. (Detailed Action, Page 5). Specifically, the Examiner contends that the EC module of Fagg is equivalent to the second spike generation circuit. (Detailed Action, Page 5). The Examiner also states that "[t]he 'second threshold' of applicant is if the arm reaches its goal or not. If the arm reached the goal, then the threshold has not been crossed. If the arm did not reach the goal, then the threshold has been crossed." (Detailed Action, Page 5).

Although the bursts generated by the EC module, which are illustrated in Fig. 5, may be viewed as spike signals, Applicants respectfully submit that the Examiner mischaracterizes the second threshold requirement of claim 12. As discussed above with respect to the first threshold, the second threshold of claim 12 corresponds to a particular signal level that an oscillation output signal crosses. The threshold pointed to by the Examiner, i.e., whether the arm reached the goal, is not the same type of threshold as contemplated by the claimed invention.

In light of the foregoing, Applicants respectfully submit that the combination of Sedra and Fagg does not disclose each of the limitations of independent claim 12, and thus, independent claim 12 is patentable over the cited references. Accordingly, Applicants request that the rejection be withdrawn.

Applicants further submit that independent claims 20, 28, 29, and 37 are also patentable over the cited references. Claims 20 and 28, like claim 12, each require first and second spike generation

circuits that generate spikes when an oscillation output signal crosses a first and a second threshold respectively. Similarly, claims 29 and 37, which are directed to methods, include the steps of generating a first and a second spike signal when an oscillation output signal crosses a first and a second threshold respectively. Therefore, the foregoing arguments with respect to claim 12 are equally applicable to these claims. Thus, Applicants respectfully submit that the combination of Sedra and Fagg does not disclose each of the limitations of independent claims 20, 28, 29, and 37, and thus, these claims are patentable over the cited references. Accordingly, Applicants request that these rejections be withdrawn.

In light of the foregoing remarks, Applicants submit that the cited references fail to disclose, teach, or suggest the features of claims 12, 20, 28, 29, and 37. Applicants further submit that claims 13-19, 21-27, 30-36, and 38-42, which are dependent upon one of claims 12, 20, 28, 29, and 37, are allowable at least by reason of dependency upon an allowable base claim. Consequently, Applicants submit that the present invention is both novel and inventive over the cited references and respectfully request that the rejections be withdrawn.

CONCLUSION

In view of the above remarks, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

The Examiner is respectfully requested to contact the undersigned at the telephone number indicated below if the Examiner believes any issue can be resolved through either a Supplemental Response or an Examiner's Amendment.

It is believed that no fee is required for these submissions. Should the U.S. Patent and Trademark Office determine that additional fees are owed or that any refund is owed for this application, the Commissioner is hereby authorized and requested to charge the required fee(s) and/or credit the refund(s) owed to our Deposit Account No. 04-0100.

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Respectfully submitted,

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